

## High-Energy Piping Analysis

An integral part of any high-energy piping (HEP) maintenance program is understanding the state of stress present in the system. Elastic finite element (FE) stress analysis is the classic means to assess stresses at critical locations such as welds, support locations, branches, and terminal points due to dead weight, internal pressure, and thermal expansion. However, as service time accumulates in high-temperature systems, creep deformation will occur and system stresses will change from their "as-designed" elastic values, redistributing based on the systems new equilibrium state. Therefore, Structural Integrity recommends that creep-redistribution analyses be performed on all high-temperature systems to provide a more representative assessment of system stresses.



*Bottom of the vertical run, Hot Reheat and Cold Reheat lines.*

### Technical Approach

Structural Integrity's methodology in assessing HEP systems involves initially performing incremental elastic FE analyses to evaluate the support system, cold-spring effects, thermal expansion, and internal pressure. The results of these evaluations are used to assess the adequacy of the support system, and how the predicted system stresses compare with established Code allowable limits. These results are then supplemented with a final analysis that incorporates the creep deformation properties of the constituent material(s), simulating secondary creep behavior over a representative service interval.

The analysis results are then available for identification of critical locations whether solely based on stress or via other ranking methodologies.

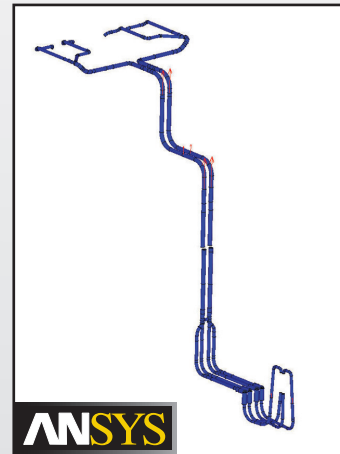
### Analysis Methodology

Structural Integrity performs HEP FE analyses accounting for creep using the ANSYS or OmegaPipe codes. The system models constructed typically simulate piping from the boiler outlet header to the turbine connections.

Information required to perform system analyses consists of the following:

- System isometrics showing run lengths, elevations, and cold spring levels.
- Support drawings showing design loads, travel, and cold/hot settings.
- Spool-piece drawings to identify girth, seam, and attachment weld locations.
- Piping specifications including size and material
- System design temperature and pressure, and accumulated service time.
- Chronology of known support modifications and/or adjustments.

Structural Integrity recommends that each system evaluation include a site visit to allow an analyst to review the above sited information and walk-down each system to establish the current condition of the supports and piping.



*ANSYS FE Model*



*Main Steam System with Support Problems.*

### Structural Integrity's Project Team

Structural Integrity's demonstrated analysis expertise coupled with our state of the art inspection capabilities can provide you with an expert assessment team and comprehensive piping management program to meet not only your immediate

outage requirements but also assist in long-term planning.

For more information contact;  
Mario Berasi, Phone: 330-899-9753;  
Email: [mberasi@structint.com](mailto:mberasi@structint.com)

or Scott Rau, Phone: 330-899-9753;  
Email: [srau@structint.com](mailto:srau@structint.com)

